Decoupled Aerobic Mineralization Tank for Detritus Reutilization in Aquaponics

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Ithaca College Aquaponics

Introduction

In an Aquaponics system, plants are grown using nutrients from the excrement created by fish. Heterotrophic bacteria break down the material and make these nutrients available. **This fish 'waste', or detritus, often builds up quickly and is discarded, resulting in a loss of vital nutrients.** A mineralization tank provides an environment for these microorganisms to flourish and "close the nutrient loop to a higher degree and thus lowering the environmental impact of aquaponic systems" (Delaide).

Why Mineralize the Fish 'Waste'?

The leftover organic matter produced from the tilapia can provide nutrients that would normally be replaced through costly artificial fertilizers. **Mineralization occurs in an aquatic environment with high concentrations of dissolved oxygen and organic matter**. After approximately, "18 days for 75% of the solids to be broken down, and 30 days for 100% solids breakdown", a 'supernatant' is achieved. This liquid, "provides a boost of nutrients to the plants, including phosphorus, calcium, potassium, and various micronutrients that are otherwise unavailable"(Sawyer). **Nitrates are an important factor in the growth of plants, and these are produced in abundance in the mineralization process.**

Redefining 'Waste'

When addressing the solids that are produced from the fish, people should move away from using the term 'waste'. Labelling it as such perpetuates a stigma that these are not valuable resources rich in minerals, merely byproducts that do not deserve to be reused. **Detritus is a more encompassing word as it, "consists of fish waste, plant matter, old bacteria, fish feed, and other detritus" that build up over time and can be processed into a natural fertilizer.** (Sawyer)

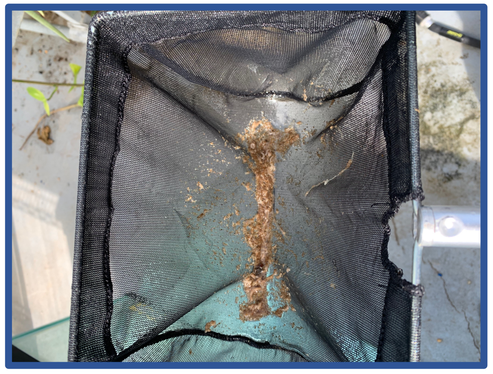

Figure 1. Detritus acquired through hand scooping with a net

Figure 2. Hot peppers growing in Ithaca College's Aquaponics system

How can Mineralization occur?

There are two forms of mineralization: aerobic and anaerobic. **This experiment is aerobic, which occurs when "oxygen is freely available, and microbes undergo respiration using oxygen" (Sawyer).** The source is from air stones powered by an air pump, which also suspend the solids.

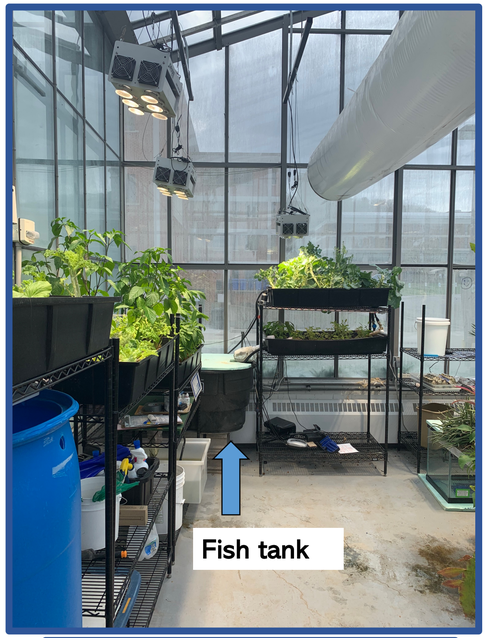

Figure 3. Ithaca College's Aquaponics system

What are signs that it works?

Things to look for:

- "Biofilms begin to form on the solids causing them to flocculate or stick together" (Sawyer)
- High nitrate levels
- A level of 0 for both nitrite and ammonia
- The pH is equal to or greater than 6.8
- Oxygen levels should be above 6.0 mg/L

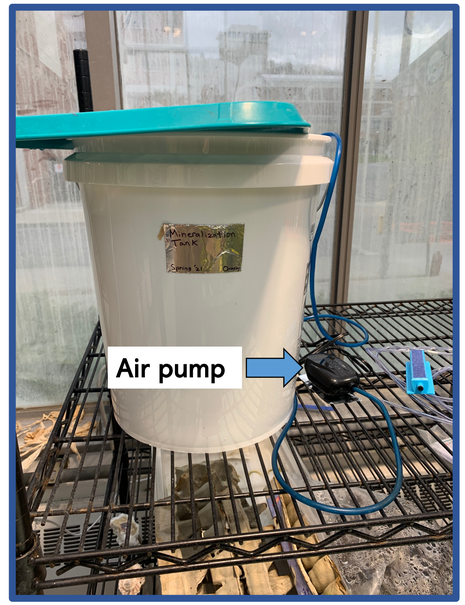

Figure 4. The experimental set up to test offline capabilities of mineralization

Results

The tank that was put together consists of **one five-gallon commercial bucket, two air stones, and one air pump rated at 1200cc/min.** After 30 days the air pump will be turned off to allow for the supernatant to be collected and deposited into the sump, which is attached to the one-hundred-gallon black tank pictured in Figure 3.

References:

Delaide B., Monsees H., Gross A., Goddek S. (2019) Aerobic and Anaerobic Treatments for Aquaponic Sludge Reduction and Mineralisation. In: Goddek S., Joyce A., Kotzen B., Burnell G.M. (eds) Aquaponics Food Production Systems. Springer, Cham. https://doi.org/10.1007/978-3-030-15943-6_10

Sawyer, Jonathan. "Aerobic Mineralization in Aquaponics." *An Overview of Mineralization in an Aquaponic System*, The Aquaponic Source, 26 Oct. 2020, www.theaquaponicsource.com/an-overview-of-mineralization-in-an-aquaponic-system/.